

Arsenic

Arsenic, a naturally occurring element, is becoming an issue of increasing concern in Wisconsin groundwater. Exposure can occur through three main pathways. It may be ingested through food or water consumption, absorbed through contact with the skin, or inhaled through the air. Depending on the exposure pathway and concentration, high arsenic levels can cause a variety of symptoms including nausea, diarrhea, vomiting, headaches, delirium, muscle spasms, numbness and tingling in the arms and legs, thickening and discoloration of the skin, decreased production of blood cells, abnormal heart rhythm, blood vessel damage, and in extreme cases, death. Long term ingestion of contaminated water has been found to increase the risk of skin cancer and increase tumors of the kidney, bladder, liver and lungs. The current PAL and ES are 5 µg/L and 50 µg/L, respectively.

Elevated arsenic concentrations were first detected in northeastern Wisconsin in 1987. In 1992 and 1993, DNR staff sampled 1943 private wells throughout northeastern Wisconsin, primarily in Winnebago and Outagamie counties. Arsenic levels of 5 µg/L or greater were found in 622 of the 1943 wells. Sixty-eight of the wells (3.5%) exceeded the ES.

Several recent studies have focused on sampling for arsenic. In 1994, the CDC Study added arsenic sampling as a component in the Northeast District (now Region). Staff sampled 113 private water supply wells for arsenic. Arsenic was detected in 75 wells, and 11 wells were greater than 5 µg/L. None exceeded the ES of 50 µg/L.

In 1994, staff from the Southern District office sampled 119 private water supply wells. Results indicated that 51 wells (43%) had an arsenic detection between 1 and 5 µg/L. Five (4%) had detects between 5 and 10 µg/L. Seven (6%) had detects between 10 and 20 µg/L, and 4 (3%) had detects above 20 µg/L. The four highest detects were found in four different counties (Columbia, Dodge, Fond du Lac, and Jefferson.)

Figure 4 illustrates the statewide distribution of drinking water wells (both public and private) that have had arsenic concentrations that exceeded 5.0 µg/L at least once during routine sampling. Note that while arsenic detections are clustered in the Fox River Valley, arsenic has been found in other areas of the state as well.

In addition to past DG staff sampling programs, two projects were funded in recent years through the GCC Joint Solicitation process, titled “A Study of Well Construction Guidance for Arsenic Contamination in Northeast Wisconsin” and “Stratigraphic Controls on the Mobilization and Transport of Naturally Occurring Arsenic in Groundwater: Implication for Wellhead Protection in Northeastern Wisconsin.” These studies concluded that the primary source of arsenic is a mineralized zone at the top of the St. Peter Sandstone at the geologic contact within the overlying Sinnipee Dolomite. As a result of these studies a special well construction casing guidance was issued for an area within 5 miles of the St. Peter subcrop in Winnebago and Outagamie counties, known as the Arsenic Advisory Area (AAA).

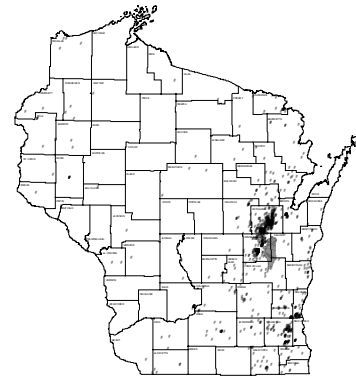


Figure 4. Drinking Water Wells Tested with Arsenic Levels > 5.0 µg/L

Ongoing research indicates that casing off the upper parts of the St. Peter Sandstone is usually effective in eliminating or reducing the presence of arsenic in drinking water. DNR guidance recommends the installation of 80 feet of casing through the sandstone contact for drinking water wells in the AAA. However, over the last several years some wells that were not constructed according to guidance have exhibited increasing arsenic concentrations and have required replacement or reconstruction. In addition, follow-up testing on 50 replacement wells found that arsenic levels are exceeding standards in at least 5 cases where initially they had been below the ES. Additional sampling of replacement wells will occur over the next 2 fiscal years to test whether current guidelines are adequate at lowering arsenic concentrations.

Recent information has raised questions about the St. Peter Sandstone – Sinnipee Dolomite contact being the only location where high arsenic concentrations are found. A renewed effort is currently underway to reexamine this problem. In addition, there is evidence to suggest that increased levels of arsenic in this region may be related to increased groundwater consumption. In many areas, increasing concentrations of arsenic may be a result of the water table dropping to levels at or just below the sulfide rich mineralized zone and then fluctuating up and down across this layer. This fluctuation can allow oxygen in the air to come in contact with and oxidize the sulfide minerals in this layer. This initial oxidation can then trigger a complex set of geochemical reactions that can eventually release arsenic into the groundwater. Once this reaction has been initiated it is likely to continue.

In May 2000, EPA proposed lowering the Federal drinking water standard for arsenic from 50 µg/L to 5 µg/L. This proposed revision is under review, but will likely take effect in FY 01. A sampling effort of 3,300 public water supply systems (Municipal, Other than Municipal, and Non-transient Non-community wells) was undertaken in the summer of 2000. Out of 2784 samples, only 2 had arsenic levels above the current ES of 50 µg/L, while 185 (6.6%) had levels that exceeded 5 µg/L. Historical data indicates that 11% of Wisconsin's public supply wells have exceeded 5 µg/L at least once. Thus the proposed standard could have a significant impact on the ability of many public water supply systems to comply with Federal Safe Drinking Water Act standards.

The proposed standard also raises questions for private water supplies, particularly in regards to health risks associated with drinking water with moderate levels of arsenic (between the old and new standards). In FY 01, the DHFS received funding to conduct a follow-up investigation on the relationship between exposure to inorganic arsenic in water and health outcomes. As part of this research effort, local health departments, DNR staff, town clerks and others have conducted well sampling campaigns in 3 townships in the affected counties. Several other towns have offered similar well testing programs. Over 550 households have submitted samples and returned health surveys, providing health and exposure information for about 1600 individuals. Historical data indicates that 37% of the wells in the 4-county area affected by arsenic exceed the 5 µg/L standard. In two of the townships, almost 50% of the samples tested in the current campaign exceed 5 µg/L.

Including the two studies mentioned above, a total of five GCC-funded projects will address issues related to arsenic in FY 01. Additional studies include an analysis of the geologic and geochemical controls on arsenic in groundwater and two studies related to analytical methods for detection and remediation of arsenic compounds. These studies will help provide needed information about the occurrence, health risks, and treatment of arsenic in drinking water supplies.